the Asiatic countries, counting only the institutions represented in last year's table, Japan sends 131, China 124 and India 49, as against 116, 84 and 39, respectively, last year. *Cornell* draws the largest number of students from China, followed by *Harvard* and *Yale; Columbia* draws more than twice as many students from Japan as the second institution, *Yale*, while *California*, as we have seen, leads in India.

The figures given in the table are intended to represent *not* the birthplace of the students, but their permanent residence, although the absolute accuracy of the table is somewhat impaired by the fact that students occasionally give as their permanent residence the state where the institution at which they are enrolled is located, this being especially true of the state universities, where students take up a temporary residence in the state to escape tuition fees.

Rudolf Tombo, Jr.

Columbia University

THE DUBLIN MEETING OF THE BRITISH ASSOCIATION, SEPTEMBER 2–9, 1908

The meeting proved to be one of the best attended and most successful ever held by the British Association for the Advancement of Science. A total of 2,270 tickets were issued, of which 1,152 belonged to the class of associate members.

The first day, Wednesday, was devoted to registration, the president's address being delivered in the evening in the graduation hall of the university. Owing to the terrific storm that had been raging on the British coasts the previous three days, most members put off crossing the Irish channel as late as possible, but even Wednesday afternoon's crossing was slightly rough. Work in the various sections started on Thursday, September 3. Nearly all the sections were housed in the grounds of Trinity College, and an inter-sectional automobile service, arranged through the generosity of local members, provided swift means for reaching outlying meeting places. The usual post-office information bureau, news stand, excursion counter, and lounge were located in the examination hall, and the daily journal gave prompt information as to the doings of the sections. A welcome and most efficient innovation were the "indicator boards," announcing what papers were being read in each section. The boards contained the letters A to L, representing the various sections, and underneath each letter was hung a card bearing the number of the paper under discussion at the moment. The "indicator boards" were kept up to date by four special operators for each section, telephonic communication proving very helpful. The number of abstracts of the papers read supplied to members proved for once adequate to the demand.

Thursday was ushered in by heavy rains, which marred the success of the Provost's garden party in the afternoon, held in the Fellows' garden. The party was well attended, however, and afforded the usual enjoyable opportunity for meeting old friends whilst listening to the music of the band and taking tea in the marquees.

Guiness's brewery was visited by parties of members on several days, and other works in the vicinity were also thrown open for inspection. A very interesting series of Irish plays was being given at the Abbey theater, and the many who went there enjoyed the novel, excellent and characteristic acting in the native plays. A record crowd attended the conversazione given by the Royal Dublin Society in the evening at Leinster House. Most of the members (about 3,000) of the society attended with friends, and their number was swelled by about 1,500 British Association members. The large house, together with the beautiful rooms in which are placed the collections

of the Dublin Museum, accommodated the visitors easily—when once they had passed the all too narrow entrance, from which extended long lines of carriages, some of which had been waiting for two hours to discharge their occupants. The scene in the galleries and down the various flights of steps in the museum was as pretty a one as the writer had ever seen. The guests were received by Lord Ardilaun, president of the society (part owner of Guiness's), the Right Hon. Frederick Trench and Sir Howard Grubb. The Lord Lieutenant of Ireland, accompanied by some of his household, arrived later in the evening.

Friday was occupied with sectional meetings, and the conferring of honorary degrees in the afternoon on Mr. Francis Darwin, F.R.S.; Sir David Gill, K.C.B., F.R.S.; Dr. William Napier Shaw, F.R.S.; Captain Henry George Lyons, F.R.S.; Professor Horace Lamb, F.R.S.; Professor Charles Scott Sherrington, F.R.S.; Professor Ernest Rutherford, F.R.S.; Professor Archibald Byron Macallum, F.R.S.; Dr. Albert Kossel; Dr. Ambrose Arnold William Hubrecht; Sir Thomas Lauder Brunton, Bart., F.R.S., and Sir James Augustus Henry Murray. In the afternoon the general committee met and decided to hold the 1910 and 1911 meetings at Sheffield and Portsmouth, respectively. Professor J. J. Thomson was elected as President for 1909.

Friday afternoon was devoted to garden parties at Dunsink Observatory and Saint Patrick's Cathedral. The Dunsink party was limited to 200, and over 700 applications had been received for tickets. A most enjoyable drive through Phœnix Park and past the Vice-regal Lodge brought the members to the observatory grounds. An old transit circle, last used in 1860, excited particular interest. In the evening a crowded audience listened to a lecture by Professor H. H. Turner, F.R.S., on Halley's comet.

Over 1,000 persons took part in Saturday's excursion, which included the Boyne Valley, Bray, Powers Court, and Kilruddery, Glendalough, the Rock of Cashel and the Shannon Valley. The Boyne Valley excursion provided a seven hours' drive in jaunting cars and included the inspection of the old tumuli at Louth and the ruins of Mellifont Abbey.

Garden parties were given on Monday, Tuesday and Wednesday by Lord Ardilaun, at the Zoological Gardens, and at the Vice-regal Lodge, but the enforced departure of the writer early Sunday morning on the *Lusitania* from Queenstown prevented his attending them.

Professor W. M. Davis, of Harvard, gave a lecture on Monday on "The Lessons of the Colorado Cañon."

All the sectional meetings were well attended. There were present from this side of the water: Professor W. M. Davis, of Harvard University, vice-president of the geological and geographical sections; Professor A. L. Rotch, Blue Hill Observatory, Mass., on committee of mathematical and physical section; Dr. Leo F. Guttman, College City of New York, on committee of chemical section; Drs. W. E. Praeger, Kalamazoo College, Mich.; Carroll Dunham, Harvard; Elizabeth H. Dunn, Chicago University; President E. J. James, Illinois; Dr. W. H. Hale, Brooklyn; N. M. Fenneman, Cincinnati, and Miss M. E. O'Brien, Boston, Mass.

Subjoined is a report of interesting papers read before some of the sections, together with an account of the discussions thereon. Notes had been taken, and an attempt has been made to faithfully reproduce the statements of the speakers, but strict accuracy is not claimed for the remarks quoted.

Abstract of Address to the Chemical Section: Professor F. S. Kipping, D.Sc., Ph.D., F.R.S.

During the past few months we have read in the daily journals—and we sincerely hope it may be true—that there are signs of the commencement of a great development of the resources of this island; as such a desirable event must be closely connected with, and, indeed, may even be dependent on, the vitality of the chemical industries of the country, the moment seems opportune for the consideration of a subject which has a direct bearing on both commerce and chemistry.

Although this section is chiefly occupied with matters relating to pure science, the discussion of industrial questions is also regarded as one of its important functions; it does not attempt to distinguish pure from applied chemistry, and any problem which concerns either is deemed worthy of its attention.

From this point of view I propose to consider whether any steps can be taken to place the chemical industries of the United Kingdom of Great Britain and Ireland in a more prominent position than that which they now occupy in the world of commerce.

The subject is not new; it has been dealt with by many, but principally by those more directly interested—prominent members of the Society of Chemical Industry, who are far better qualified to express opinions on commercial matters than am I. It is perhaps presumption on my part to attempt to add anything to what has been said by such leaders of industrial chemistry, but I propose to deal with the subject from a very different standpoint—namely, from that of the teacher in the class-room and laboratory. Even if I fail to make a single suggestion of immediate practical value, the question is one of such magnitude and so many-sided that I feel justified in bringing it under the notice of this section. It is not merely a matter of money, of a few millions or of a few tens of millions sterling. There are few branches of industry to which chemistry, in one way or another, is not of supreme importance. Whether we look to the great shipbuilding interests, dependent on the progress of metallurgy; to our cotton and linen trades, where cellulose reigns supreme; to our dye-houses or to our breweries, or to any other industry, great or small, there do we find problems in chemistry awaiting solution, and the nation which solves them will not only progress in civilization and contentment, but will also justly claim to have taken a leading part in the advancement of science.

It is unnecessary to trouble you with any detailed comparison of the position which we occupy to-day with that which we have taken in the past. The fiftieth anniversary of the epoch-making discovery of mauve was held only two years ago, and the proceedings are still fresh in our recollection; the pæans of congratulation addressed to the discoverer (now, alas! no longer with us) were marred by a plaintive note, a note of lamentation over our lost industry, the manufacture of dyes. The jubilee of the founder of the color industry in this country was also the occasion for pronouncing its funeral oration. If this were the full extent of our loss we might bear it with equanimity; but it is not so much what has already gone as what is going and what may go that are matters of such deep concern. Those who doubt the seriousness of our condition may find statistical evidence, more than sufficient to convince them, in the technical journals and in the board of trade reports of recent years.

The new Patent Act which came into force this year, and for which the country is so much indebted to the strenuous advocacy of Mr. Levinstein and Sir Joseph Lawrence, seems to many to have inaugurated a new era, and to have removed one of the principal causes of the decline of our chemical industries; if this be so, it is all the more important that the representa-

tives of chemical science should be ready and willing to join hands with the manufacturers in order to assist in the process of regeneration.

The principal changes which have been introduced by the new law are, of course, familiar to all. The most important one, which came into operation on August 28 last, is that which requires that the article or process which is protected by the patent must be manufactured or carried on to an adequate extent in the United Kingdom after the expiration of four years from the date of the patent. If this condition is not fulfilled, any person may apply for the revocation of the patent.

Some of the results of this amendment, and some indications of the great industrial changes which it will bring about, are already obvious. Foreign firms or individuals who hold British patents and who have not sufficient capital to work them in this country, or who do not think they are worth working here, are attempting to sell their British patent rights. Others are building or buying works in Great Britain, and it has been estimated that in the immediate future a sum of at least 25,000,000*l.* of foreign capital will have been thus invested in order to comply with the new law.

We need not stop to consider the economic effects of this transfer of capital on the general trade of this country, but we may well pause a moment in order to try and forecast the consequences of these new conditions in so far as they concern our chemical industries.

The prospective establishment of branches of two of the largest German chemical works at Ellesmere Port and at Port Sunlight, respectively, is already a matter of common knowledge, and it may be presumed that these firms will avail themselves to a large extent of British labor. If this be the case, and if they are successful—as they, no doubt, will be—the complaint that the inferior technical education of our artisans is responsible for our lack of success will thereby be proved to be groundless. Even if we admit that at the present time the British workman is an inferior operative in a chemical works, and only capable of undertaking the less-skilled labor, these firms will gradually raise a considerable number of trained men who will be ready to undertake more responsible duties under our own manufacturers when the good time comes; a school for chemical operatives will be created in our midst, and, as in the past, we shall reap the benefit of knowledge and experience brought to our shores. It also seems reasonable to expect that, as is the case abroad, these works will be equipped with laboratories and staffed by chemists, although possibly only so far as is necessary for routine work. Many of these chemists may settle permanently in our midst, become members of our Chemical Society and Society of Chemical Industry, and thus infuse us with their patience and perseverance. It is not beyond the bounds of possibility that these great firms may even employ British chemists in their works, if we can supply men sufficiently well trained to be of value. On the other hand, as experience seems to have shown that industrial chemistry can not succeed with imported scientific labor, it is not very probable that many posts in the laboratory will be filled by our countrymen, who, in this connection, must be regarded as foreigners.

Now at the present time most chemical products can be manufactured more cheaply abroad than here, otherwise we should not have any reason to consider our position. Even if, owing to inefficient labor, higher wages, freight and other economic conditions, production is more costly here, the superior efficiency and sci-

entific organization of these foreign firms will nevertheless enable them to command our home market with the goods made here.

The conclusion which thus seems forced upon us is that, although the new Patent Act will prove to be of great value in many respects, it will do little to foster British chemical trade and the developments of British chemistry; it places us on an equality with other countries as regards patent rights, and thus remedies an outstanding grievance; but unless we have something to patent, this equality will be valueless and our chemical industries will continue to decline, possibly more rapidly than heretofore.

Among the other causes which have been suggested as contributory to our failure are: (1) The unsatisfactory condition of secondary education; (2) the nature of the training which is given to chemists in our universities and other institutions; (3) the insufficiency of the time and money devoted to research in the manufacturing industries; (4) the lack of cooperation between manufacturers and men of science. There are some of us who believe that the first of these is the primary. . . .

In a presidential address to the Chemical Society last year Professor Meldola discussed the position and prospects of chemical research in Great Britain, and in view of the importance of the subject and the able manner in which it had been treated, the Council of the Society ordered the publication of five thousand copies of his address for distribution among the members of various public bodies. We were told in this address that many of our universities are distinct failures as centers of chemical research, and that the output of original work from our colleges, polytechnics and similar institutions is emphatically not representative of the productive power of the teachers there employed. The causes of the failure of our universities were only lightly touched upon, and I propose to refer to them later; but in the case of our other institutions they were more fully discussed. May I venture to draw attention to one cause, which I believe is by far the most effective drag on research in the vast majority of such institutions not of university rank? It is simply the lack of those more advanced students who, while gaining valuable experience in the methods of research, would also render useful assistance to their teacher. The governing body of the institution may not realize the importance of research; the principal, as, alas! is sometimes the case, may throw cold water on such work; the teacher may be overburdened with routine duties, and he may be most inadequately remunerated; if, however, the research spirit is strong within him, he would overcome all these difficulties were there any prospect whatsoever of success; but what chance has he when he must do everything himself, even to washing out his own test-tubes? Provide him with a few advanced students, and he would doubtless find time to undertake the necessary pioneer research work, which would then be extended and developed with their assistance.

It might be suggested that an efficient and enthusiastic man would soon attract a number of research students. This, no doubt, is true as regards the universities, but it must be remembered that a polytechnic or other institution which does not grant degrees can hardly expect to compete with a university as a center for research; all those students who intend to undergo a so-called "complete" course of study—that is to say, all who are likely to become capable of undertaking research work—naturally proceed to one of the degree-giving universities. There are not enough students to go round, to satisfy the research requirements of the teachers, and

the principal reason is—the limited demand for trained chemists on the part of the manufacturers.

Even of the small number of those who leave our teaching institutions fairly well trained in research, how many have a chance of passing into works and directly advancing applied science? A very small proportion indeed. Most of the better ones drift into other posts, become demonstrators, emigrate—anything rather than wait on with the prospect of accepting as works-chemist a salary which, meager though it be, may be stopped altogether if dividends are low.

With whom rests the responsibility for this state of affairs? Is it with the teachers, and, if so, is it because they are incapable of training chemists or because their system is at fault?

To answer this question it is necessary in the first place to arrive at some conclusions as to the kind of training which is required for the future works-chemist. On consulting the opinions of the manufacturers it would seem that they attach great importance to what is called the "practical side"; they believe that, in addition to a knowledge of theoretical chemistry, the prospective works-chemist should also have some acquaintance with engineering, should understand the apparatus and machinery used in the particular manufacturing operations with which he is going to deal, and should have had practical experience in working the given process. It is from this point of view that we build and equip large technological chemistry departments, such as those in the Universities of Birmingham and Leeds and in the Manchester Municipal School of Technology, departments fitted up with complete apparatus and machinery for carrying out operations on a miniature manufacturing scale.

The arguments in favor of this view, that it is a hybrid chemist-engineer who is required in a chemical works, seem to me to be fundamentally unsound, and the kind of training suggested by them for the works-chemist can only result in the production of a sort of combined analytical machine and foreman. A two or three years' course of science, followed by one year's practical work in the dye-house, in paper-making, or in some other technological department, is quite inadequate if the student trained in this way is expected to do anything beyond routine analytical work and supervision. We can not possibly expect such a poorly trained jack-of-all-trades to run a chemical works successfully in the face of competition directed by a large staff of scientific experts in chemistry and in engineering. The conditions in a chemical works can not be successfully imitated in a university or polytechnic; attempts to do so can only lead to mistaken conclusions, and thus have the effect of rendering the works-chemist quite helpless when he passes from the elegant models of his educational apparatus to the workaday appliances of the manufactory.

Here, it seems to me, we touch the bedrock of our trouble. The state of our chemical industries must be attributed to the erroneous views which have been and still are held as to the functions, and consequently as to the training, of a works-chemist. We have failed to realize that industrial chemistry must be based on a foundation of continuous and arduous research work. In the past we have sent out from our universities and other institutions students who no doubt were qualified to undertake routine analytical work, but the great majority of whom knew nothing of the methods of research. We are doing the same to-day. Just when a student has reached a stage at which his specialized scientific training should begin his course

is finished, and whether he has been to a university or to a polytechnic matters little; he joins the band of those who subsist on but who do nothing to advance chemical industry. He enters a works; the manufacturer does not realize exactly what his chemist ought to do, but he expects some immediate results, and in consequence is generally disappointed; the lack of success of the chemist is put down to his ignorance of practical matters, and there is an outcry for technical education; science is most unjustly discredited, and any suggestion of spending money on research work is scouted as a mere waste.

The consequence is that if there is a scientific problem which intimately concerns all the members of some large industry, what course do they adopt? Through their trade journal, and as an association representing a total capital of which I should not like to hazard a guess, they offer a bronze or possibly a silver medal, or may even offer the extravagant sum of 20*l.*, to the happy person who will provide them with a solution. It is difficult to imagine the class of solvers to whom these princely rewards may appeal, more difficult still to believe that any useful result can be attained, and it is almost incredible that such methods should be adopted by any influential industrial organization. This way of attempting to get research work "on the cheap" is certainly not unknown even in more enlightened countries, but that is hardly a sufficient justification for its employment.

Contrast these methods with those adopted by the Badische Anilin- und Soda-Fabrik and Meister, Lucius & Brünig in their attempts to solve the problem of the commercial synthesis of indigo. Could there be a greater antithesis? If five thousand copies of Brunck's Paper on this subject[1] could be circulated among the manufacturers of this country—a task which might be fittingly undertaken by the Society of Chemical Industry—the study of the truly magnificent results attained by the systematic application of pure science, and of the indisputable evidence of their commercial value, might prove an object-lesson far more effective than argument for the accomplishment of a sorely needed reform.

Now if we are to meet successfully the very formidable scientific and commercial organization opposed to us in chemical industry, we must perforce adopt the methods of our competitors; not only must we learn patience and perseverance, but we must also call to our aid the best brain-power available. We must recognize clearly that the scientific-works chemist, the only man who is likely to make discoveries of commercial value, must be thoroughly trained in the methods of research by those best qualified to do so, and we must not imagine that when he enters the works he should or could immediately become an engineer and a commercial expert; his place is in the research laboratory. The practical man—that is to say, the man who has a thorough and useful knowledge of some particular manufacturing process—must be trained under practical men in the works, and we must not imagine that a course of evening classes will convert him into an expert chemist. The ideal man who combines high scientific training and sound practical knowledge can not be produced unless the period of his education is extended to half a lifetime, and even then only through the cooperation of the chemistry teacher and the manufacturer.

The great proportion of the original work now done in this country, judging from the published records, is absolutely free from any utilitarian bias; the time, brain-power and money devoted to this work are considerable, and the results from a scientific

[1] *Ber.*, 1900, I., lxxi.

point of view eminently satisfactory. If even a fraction of the same skill and energy were brought to bear under proper conditions on problems of applied science, who can doubt but that the effect on our chemical industries would be one of vast importance? And yet it is the rarest possible occurrence to find any record of research work undertaken with a commercial object even in the natural home of such records, the *Journal of the Society of Chemical Industry*.

One reason for this may be that the discoveries made in the works-laboratories are not given to the world at large, but are quietly and lucratively applied in some secret manufacturing process. Another reason, unfortunately the more probable one, may be that nearly all the principal research workers are completely shut off from any industrial influences.

Now the worker in pure science, unaided by the advice of the manufacturer and business man, has little chance of solving any important technological problem, except as the result of accident; he has not the requisite acquaintance with commercial conditions, does not realize the enormous difference between operations on the laboratory and the manufacturing scales, or, if he does so, is unable to enter fully and with confidence into questions of fuel, labor and so on, which often determine the success or otherwise of a process. Further, much of the research work of direct commercial value concerns methods for reducing the cost of processes already in operation, and demands an intimate practical knowledge of these processes.

It is obvious, therefore, that, even if all the research capacity of the country were henceforth devoted to purely technical matters, any great improvement in our industries could hardly be anticipated without the active cooperation of the manufacturers.

There are other ways in which it might be possible to obtain the active cooperation of the manufacturers. Any individual or firm interested in a problem of applied science might be invited to found a temporary research scholarship at the university or other institution for the definite object of the particular problem in question. The maximum period during which such a scholarship would be tenable might be fixed beforehand, so that the financial liability of the founder would be limited and proportionate to the importance of the object in view. The holder of the scholarship might be nominated by the university, or by the founder and the university jointly, and suitable conditions would be drawn up to insure the interests of the founder; he would, of course, have the benefit of all the results of the work, and would secure the patent-rights of any new invention, subject possibly to the payment of a small percentage of the profits to the university and to the holder of the scholarship. During the tenure of the scholarship the holder, and also the founder, would have the advantage of the scientific knowledge of the university; the scholarship holder would also be allowed to gain practical experience in the works, and, if successful, there is little doubt but that he would have the option of working the process on the large scale and of obtaining permanent employment under satisfactory conditions. After a given period the scientific results of the work would be published through the usual channels in the ordinary way.

This idea of applied research scholarships had taken shape in my mind when I happened to come across a book recently published in the United States, called "The Chemistry of Commerce," in which I found that a similar proposal had been made by the author, R. K. Duncan, professor of industrial chemistry at the University of Kansas. The scheme is there worked out in some detail, and a form of legal agree-

ment to be signed by the university authorities and by the founder of the "Industrial Fellowship" is suggested.

In drawing this address to a conclusion I can not but feel that my suggestions may seem utterly inadequate to the attainment of those important results which are so greatly to be desired. If so, I can only plead that more drastic measures are hardly available, and that even under the most favorable circumstances improvement can take place only very slowly. Whatever differences of opinion may be held as to the details of any scheme for regaining our lost ground, the main lines seem to be clearly indicated. The workers in pure science must recognize that it is their duty to do all they can to promote the industrial welfare of their country; the manufacturers must concede the paramount importance of science and the impossibility of dispensing with its counsels. Guided by these principles and by a spirit of cordial cooperation, a sustained and strenuous effort on the part of the leaders of chemical industry and of chemical science can hardly fail to accomplish the end in view.

A Determination of the Rate of Evolution of Heat by Pitchblende: HORACE H. POOLE.

A spherical vacuum jacketed vessel with a narrow neck is filled with powdered and carefully dried pitchblende. The neck is filled with cotton-wool and rendered water-tight with sheet rubber, and the whole is buried in ice. The difference of temperature between the layer of pitchblende in contact with the bottom of the vessel and the ice is measured by a sensitive thermo-couple. After about a fortnight this temperature becomes steady, when the heat leakage across the walls of the vessel is equal to the heat generated by the pitchblende. The leakage depends solely on the vessel and on the difference of temperature between inner and outer walls, which is measured by the thermo-couple. The thermal conductance of the vessel is found by substituting water for the pitchblende and determining its rate of cooling. Hence the heat leakage is known, and, knowing the amount of pitchblende present, the heat evolution per gram is found.

The thermo-couple is calibrated by placing one junction in finely broken ice and the other in a mixture of broken ice and water, which can be subjected to a known pressure. The deflection caused by the resulting small change of temperature is noted, and hence sensitiveness of couple is found.

Using 560.7 grs. of pitchblende in an atmosphere of nitrogen, the temperature finally steadied at 0.0092° C. As the thermal conductance of the vessel is 5.8 calories per hour per degree difference of temperature between inside and outside, this corresponds to a heat leakage of 0.053 calorie per hour. Hence heat evolution per gram of pitchblende is 0.000094 calorie per hour. This is about twice the quantity estimated from the known amount of radium present.

Do the Radio-active Gases (Emanations) belong to the Argon Series? SIR WM. RAMSAY, K.C.B., F.R.S.

The residues of the fractionation of 120 tons of liquid air obtained from Claude were examined in the chemical laboratory of University College by Professor Moore. After removal of oxygen and nitrogen, argon, krypton and xenon remained, and were separated by methodical fractionation. The xenon amounted to about 300 cm.^{3}; it was methodically fractionated at $-130°$, and a final residue of 0.3 cm.^{3} was obtained. The spectrum of this portion was photographed, and differed in no respect from that of xenon. It is practically certain that if this residue had contained 1 per cent. of a denser gas, that gas would have

been detected. It follows, therefore, that if there is a heavier constituent in air than xenon, its amount does not exceed $\frac{1}{25}$ billionth of the whole. Now, it is certain that if such an element existed, it would be gaseous, and would be found in air. Its non-existence implies either the absence of such elements from the periodic table or their instability. As possible atomic weights for missing elements are 178, 216 and 260, it is rendered probable that they are, respectively, unstable emanations—those of thorium, of radium and of actinium.

The liquid residue as obtained amounted to about 500 c.c. (500 liters gas) and in order to concentrate the noble gases was blown off into about 100 c.c. of liquid air. This liquid air which contained the accumulated noble gases was again blown off into a smaller volume of liquid air, and this process continued until a manageable quantity of liquid was obtained for fractionation.

The breaking down of the various emanations into members of the argon family was also mentioned. In the discussion that followed Professor Rutherford stated that he was repeating Ramsay's experiments on the production of neon and argon from copper salts by radium emanation and seemed to obtain different results.

A discussion on the "Nature of Chemical Change" was opened by Professor H. E. Armstrong, F.R.S., who attacked in vigorous terms the theory of ionization in solution, propounding instead a theory of hydrogenation. From the fact that enzymes become associated with the substances they hydrolyze he concluded that acids in solution also acted as true catalysts. Water does not exist as H_2O, but as polymerized molecules, such as

$$\mathrm{H_2O}\langle^{\mathrm{H}}_{\mathrm{OH}}$$

hydronol,

$$\begin{array}{c}\mathrm{H_2O{-}OH_2}\\ \diagdown\;\diagup\\ \mathrm{O}\\ \mathrm{H_2}\end{array}$$

di-, tri- and polyvalohydrone. HCl dissolved in water yields $HCl{=}OH_2$ and

$$\mathrm{HCl}\langle^{\mathrm{H}}_{\mathrm{OH}}$$

(hydrolation), and in part

$$\mathrm{H_2O}\langle^{\mathrm{H}}_{\mathrm{Cl}}$$

which readily hydrolyzes. $H_2O{=}$ and $HCl{=}$ are active because unsaturated. In opposition to the ionic theory Professor Armstrong postulates:

$$1.\ \mathrm{HCl}\langle^{\mathrm{H}}_{\mathrm{OH}} + {}^{\mathrm{OH}}_{\mathrm{H}}\rangle\mathrm{O}\langle^{\mathrm{H}}_{\mathrm{Na}} = \underset{\mathrm{OH}}{\mathrm{HCl}}{-}\underset{\mathrm{H}}{\mathrm{O}}\langle^{\mathrm{H}}_{\mathrm{Na}} + \mathrm{OH_2}$$

$$2.\ \underset{\mathrm{OH}}{\mathrm{HCl}}{-}\underset{\mathrm{H}}{\mathrm{O}}\langle^{\mathrm{H}}_{\mathrm{Na}} + \mathrm{OH_2} = \mathrm{HCl{:}OHNa} + 2\mathrm{OH_2}$$

$$3.\ \mathrm{HCl{:}OHNa} + 2\mathrm{OH_2} = \mathrm{NaCl} + 3\mathrm{OH_2}$$

and adduced in proof figures showing the volume changes after reaction.

On electrolyzing HCl in concentrated solution there are mostly present

$$\mathrm{H_2O}\langle^{\mathrm{H}}_{\mathrm{Cl}}$$

molecules, water exerting a greater hydrolyzing effect when there is less of it present. Hence in weak solution more groups

$$\mathrm{HCl}\langle^{\mathrm{H}}_{\mathrm{OH}}$$

exist and more O_2 is produced on electrolysis. The tendency for the complex molecules to produce simpler ones $(H_2O)_n \rightarrow nH_2O$ is the cause of osmotic pressure.

Of those who took part in the discussion Sir Oliver Lodge likewise expressed a preference for the attachment of water molecules to the HCl molecule, simply prefer-

ring a larger number than one, and pointing out that *then* there was little difference between the ionic theory and Professor Armstrong's.

Sir William Ramsay thought discussion was futile in view of the fact that the compounds formed by the electrons and the parts of the molecules, *e. g.*, the ions and their electric charges, had not been considered. He had thought that measurement of surface tension in mixed liquids might solve the problem, and had made a large number of such measurements, but the figures had been found absolutely inexplicable by Van der Waals and himself. The reason for this was to be found in the difference in composition between the surface layer and the interior.

Dr. Findlay pointed out that although Professor Armstrong condemned existing theories he had nothing to offer in their stead, and that he had no quantitative evidence to support the views put forward by him.

Professor Donnan in some trenchant remarks pointed out that Professor Armstrong's views were antedated by those of Werner, Bruehl and Kohlrausch.

Dr. Wilsmore remarked that according to Armstrong's theory the conductivity of a solution should vary as the square of the concentration, which like other deductions was contrary to fact.

Professor W. J. Pope stated that Professor Armstrong was really only trying to harmonize the ionic theory with the views of chemists, by picturing the process of solution by formulæ like the structural formulæ used in organic chemistry.

Sir James Dewar read a paper on "the production of helium by radium."

Quartz vessels and glass joints were used throughout; the radium was that which had been so carefully purified by Dr. Thorpe (70 mgrs.). The Crookes radiometer was used to measure minute pressures. Solid mercury warmed up to —23° just again starts the Crookes' radiometer, corresponding to a pressure of $\frac{1}{50} \times 10^{-6}$ mm. The radiometer had to be washed out with oxygen prepared from potassium perchlorate.

When a McLeod gauge filled with air was attached to a tube cooled by means of liquid hydrogen to condense the air, the pressure was reduced to 0.015 mm. representing the uncondensable gas at 20° absolute. On again filling with old air (rich in residues) the pressure was 0.00051 mm. which became reduced to 0.00002 mm. on washing out with oxygen prepared from potassium permanganate. Hence it was concluded that helium and neon adhere to glass in the form of a film, and that one can be easily deceived in measuring low pressures.

When 5 milligrams of radium were connected to the radiometer it (the radiometer) became active after a few hours, although an attached tube containing charcoal was cooled by liquid air. The amount of helium produced by 70 mgrs. of radium was measured in this way, the gases produced having to traverse a U tube filled with charcoal and cooled by liquid air before reaching the McLeod gauge. After one month's experiment a yield of 0.43 c.mm. of permanent gas per gram of radium per diem was obtained, but some of the radium emanation had diffused into the McLeod gauge and acted on some organic matter or moisture, producing a higher result. On heating up the charcoal, no helium or other gas was given off.

On repeating the experiment with all care, and under the most favorable conditions (any moisture or organic matter being now evidently eliminated), the radium salt being kept one month in vacuo and the glass containers constantly heated, 0.37 c.mm. of helium per gram of radium per diem was obtained. This corresponded

almost exactly to the amount theoretically predicted by Rutherford. Cameron and Ramsay had found eight times as much.

Sir James Dewar also mentioned that some of the calculations of the Hon. J. R. Strutt, regarding the amount of radium in the earth's interior, needed revising, for one well in France produced 30 liters of helium per day, corresponding to 100 tons of radium.

Some Reactions of Dichloro Urea: F. D. Chattaway, D.Sc., F.R.S.

Urea is so well known and has been so much investigated that any new simple substance obtainable from it possesses quite an unusual amount of interest. Such a new substance is found in dichloro urea, which, leaving out of consideration the derivatives of ammonia itself, is one of the simplest possible compounds containing halogen attached to nitrogen. It is produced when chlorine is passed into a cooled saturated aqueous solution of urea. Action takes place without any considerable development of heat, and dichloro urea crystallizes out as a white powder consisting of small transparent plates. Dichloro urea gives all the characteristic reactions of a typical nitrogen chloride; for instance, it liberates iodine from hydriodic acid, chlorine from hydrochloric acid, and reacts with alcohol, forming ethyl hypochlorite, urea being in all cases reformed.

A reaction which indicates the use to which dichloro urea may be put in the synthesis of simple carbon and nitrogen rings is that between it and ammonia.

When ammonia in excess is added to an aqueous solution of dichloro urea, hydrolysis, accompanied by liberation of nitrogen and formation of carbonate, occurs, but in addition diurea is produced, and separates in considerable quantity as a sparingly soluble crystalline powder. This is the first direct synthesis of diurea from urea itself, the compound having been previously obtained from ethyl carbonate and hydrazine.

This adds another to the very few reactions known by which nitrogen atoms can be made to link up together, and further affords an exceedingly simple synthesis of hydrazine.

Diurea, when heated with excess of strong sulphuric acid to a little above 100° C., is easily hydrolyzed, carbon dioxide escapes, and hydrazine sulphate is produced. This crystallizes out perfectly pure in almost theoretical amount on cooling and adding a little water.

The Factors which Influence the Rate of Acoholic Fermentation: Arthur Slator, Ph.D., D.Sc.

The transformation of glucose into alcohol and carbon dioxide by the action of yeast is probably not a single chemical reaction but a series of reactions. If one reaction of the series proceeds relatively much more slowly than the others, then the velocity of the transformation is determined by the rate of this slow reaction.

Evidence is brought forward to show that the initial rate of fermentation by living yeast is controlled almost completely by one single reaction.

The rate of fermentation is exactly proportional to the amount of yeast present. The rate of fermentation of the four fermentable hexoses (glucose, fructose, galactose and mannose) is almost independent of the concentration of the sugar. Glucose and fructose are fermented at approximately equal rates. The fermentation of mannose is similar to that of glucose, but the rates of the two reactions are not equal. The enzyme which ferments mannose seems to be more sensitive to heat than the one which ferments glucose. The influence of temperature on these reac-

tions is almost the same in the case of glucose, fructose and mannose, but rather less in the case of galactose. These results are most easily brought into accord on the assumption that the enzyme combines with the sugar.

Fermentation by yeast-juice differs in many respects from that by living yeast. It is probable that the mechanism of the reaction is the same in each case; but the relative rates of the different steps in the two processes are different. The experiments show that there is an essential step in fermentation in which phosphates in some form or another play a part.

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(To be concluded)

SIXTEENTH INTERNATIONAL CONGRESS OF AMERICANISTS

THE Sixteenth International Congress of Americanists was held in Vienna from Septemper 9 to 15. The congress was well attended, particularly by students from South America. Representatives were also present from Russia, Sweden, Denmark, Germany, England, Holland, Belgium, France, Spain and Italy. The attendance of ethnologists from the United States was not as great as might have been desired.

Owing to the presence of a considerable number of South Americans, many of the subjects discussed before the congress related to the archeology of that continent. Mexican archeology was also well represented; while the ethnology and archeology of North America, which at the Fifteenth Congress of Americanists played a particularly important part, was hardly discussed at all. Following is a list of the papers read before the congress:

Franz Boas (New York), opening address, "The Results of the Jesup Expedition."

Sir Clements Markham (London), "Some Points of Interest in the History of the Incas by Sarmiento."

William Thalbitzer (Copenhagen), "The Angakoks or Pagan Priests of the Eskimos of Ammasalik, East Greenland."

Paul Ehrenreich (Berlin), "Über unsere gegenwärtige Kenntnis der Ethnographie Südbrasiliens."

Franz Ritter von Wieser (Innsbruck), "Die Weltkarte des Pierre Destelier von 1553, im Besitze Seiner Exzellenz des Grafen Hans Wilczek."

Franz Heger (Vienna), "Die archäologischen und ethnographischen Sammlungen aus Amerika im k. k. naturhistorischen Hofmuseum in Wien."

Antonio Sanchez Moguel (Madrid), "Intervención de Fray Hernando de Talavera en las negociaciones de Colón en los Reyes Católicos."

Adela C. Breton (Montreal, Canada), "Exhibition of a Copy of the Ancient Plan in the Museo Nacional, Mexico, supposed to be Part of a Plan of Tenochtitlan."

Jean Denucé (Uccle-Brussels), "Une grande carte de l'Amérique, par les Reinel (vers 1516)."

Manuel M. de Peralta (Paris), "Sur les aborigènes et la cartographie de l'Amérique Centrale et spécialement de la région comprise entre la 8° et le 15° de latitude Nord."

Ignacio Moura (Paris), "Sur le progrès de l'Amazonie et sur ses indiens."

J. Kollmann (Basel), "Kleine Menschenformen unter den eingeborenen Stämmen von Amerika."

Robert Lehmann-Nitsche (La Plata), "Zur physischen Anthropologie der westlichen Chacostämme."

A. Wirth (Munich), "Die Autobiographie Franz Urban Rawiers (um 1720)."

Sir Clements Markham (London), "A Comparison of the Ancient Peruvian Carvings on the Stones of Tiahuanaco and Chavin."

Professor Dr. Capitan (Paris), "Les grands anneaux de poitrine des anciens Mexicains. Comparaisons avec les anneaux japonais, chinois, océaniens et les pièces similaires préhistoriques de la Gaule."—"L'entrelac cruciforme dans l'antiquité américaine, au Japon, en Chine, aux Indes et en Gaule."—"L'omichicahuatzli mexicain et son ancêtre de l'époque du renne Gaule."

J. D. E. Schmeltz (Leiden), "Die niederländische Tumac Humac-Expedition in Surinam."

L. C. van Panhuys (The Hague), "A Remarkable Book on the Indian Mind."—"Communications about Ethnography and History of Surinam."

Heinrich Pabisch (Vienna), "Der Fischfang mit Giftpflanzen in amerikanischen Gewässern."